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THE REVIEW

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Definition of "Hardenability" Opens Lecture

Various Tests for This Property Are Described in Detail by Boegehold at Detroit

Detroit Chapter—The term "hardenability" is commonly used to denote the capacity of steel to be hardened, and usually, though not always, depth of hardening is indicated. The capacity of steel to be hardened is determined by the cooling rate necessary to obtain a martensitic structure and prevent the formation of pearlite.

With this definition W. E. Jominy of General Motors Research Laboratories opened a talk on "Hardenability" before the ferrous section of the Detroit Chapter on Jan. 10.

For plain carbon steel of eutectoid composition, said Mr. Jominy, the cooling rate at 1000° F. must be somewhat over 700° F. per sec. to obtain all martensite, whereas for nickel-molybdenum steel of eutectoid composition, the cooling rate at 1000° need only be 7° per sec.

New Test Procedure

A hardenability test has been developed which consists in water cooling one end only of a cylindrical test bar and measuring the hardness from the water cooled end to the opposite end. The test bar is 1 in. in diameter, 3 in. long and one end is cupped so that when water is sprayed in this end it is deflected down and only the bottom face of the test bar is water cooled. By this means a wide range of cooling rates is obtained on the test bar.

This test may be applied to carburizing steels in the carburized condition, to the core of carburizing steels, or to medium carbon steels, plain or alloyed. The test bar is heat treated the same as the steel under consideration except that it is water cooled at one end only.

In other words, if a steel is to be carburized and quenched from the car-

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Compliments

To Henry Butler Allen, past chairman Philadelphia Chapter, director of the Franklin Institute since 1935 and chairman of the Museum Committee since 1933, on his election as secretary of the Institute.

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To Carnegie Tech's **Robert Franklin Mehl**, director of the Metals Research Laboratory and head of the Department of Metallurgy, on his selection by Pennsylvania State College to deliver the 12th annual series of Priestley Lectures the week of March 21 to 25.

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To **Ad Schaefer**, vice-chairman and "ex-best secretary-treasurer" of the Philadelphia Chapter, on his promotion to the position of test engineer of the Midvale Co.

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To the **Porcelain Enamel Institute**, on the appointment of **Charles S. Pearce**, oft-time METAL PROGRESS contributor, as secretary of the Institute.

A.S.M. President Visits Milwaukee

Milwaukee Chairman W. J. Sparling of Chain Belt Co. (Left) and Vice-Chairman Samuel L. Hoyt of A. O. Smith Corp. (Right) Were Obviously Pleased to Have A.S.M. President Waterhouse as Speaker at the January Meeting (Courtesy the Milwaukee Journal)

Metals Handbook Exhausted

Since the 1936 edition of A.S.M. Metals Handbook is completely exhausted, it will be impossible to supply individuals who sign applications for membership with copies of the Handbook until the new edition is printed.

As soon as the new Handbook is ready, which will be in about eight months, members who have joined the Society in the intervening time will be sent a copy automatically.

Although 13,000 copies of the 1936 edition were printed, the unforeseen growth of Society membership in recent months exhausted the supply much sooner than expected.

Copper Properties Compared to Other Common Materials

By Gordon Sproule

Montreal Chapter—At the February meeting Chairman Collitt announced the arrival of the 250th member, who joined in time for the meeting.

During coffee talk period, Canadian Copper Refiners Ltd. showed an excellent sound film of the Noranda Enterprises illustrating the mining, smelting and refining of copper and gold; underground and other difficult shots were exceptionally good.

The lecturer of the evening was C. W. Clark, metallurgist and assistant works manager of Canadian Copper Refiners. After a short historical introduction, Mr. Clark outlined briefly the properties of copper and compared it with other common metals.

Modern electrolytic copper in wire bar form is 99.96% pure, the balance being chiefly oxygen. It has eight-tenths the conductivity of silver, the only metal that exceeds it. It is very plastic and may be drawn down into wire almost indefinitely; about 80% of the copper produced is used for electrical purposes. Most other uses are dependent on its excellent resistance to corrosion.

Mr. Clark next gave a description of the electrolytic refining process by which the crude copper received from

(Continued on page 4)

Deals Telling Blow to Dry Technical Meetings Reports Local Newspaper

Milwaukee Chapter—"A professor of metallurgy from Massachusetts Institute of Technology came to town Tuesday, dealt the usual stuffy meetings of technical experts a telling blow and departed Wednesday with the plaudits of his audience still sweet music to his ears."

So said the Milwaukee *Journal* of A.S.M. President Waterhouse's address on "Metallurgical Pioneers" before the Chapter on Jan. 11. (The gist of this talk is briefly abstracted on page 2 of this issue.)

"Dr. Waterhouse," continued the *Journal*, "reached back and brought forth the men—some dead and some not—who are responsible for a few of the steel industry's basic processes. . . .

"As national president of the American Society for Metals, the professor of metallurgy from Massachusetts Institute of Technology carries the photographs and the mental pictures of the great steel scientists around with him as lovingly as a child its doll; tells about them as unaffectedly."

Strip Formed Directly From Molten Metal

New Yorkers Hear First Public Speech by Inventor of Revolutionary Process

By J. Z. Briggs

New York Chapter—The first public speech by C. W. Hazelett, chairman of the Board of Hazelett Metals, Inc., on his revolutionary process of direct fabrication of molten metals featured the meeting on Jan. 10.

The Chapter first heard an amusing coffee talk by C. C. Lawrence, operating manager of the Chrysler Bldg. in New York, telling of the trials of managing a skyscraper.

Mr. Hazelett explained that his process consists essentially in casting and rolling the metal between rotating rolls from which it emerges as strip. The rolls extract only enough heat from the metal to allow a very thin section to solidify on each revolution.

Since the rolls can cool for most of the revolution, and since the heat extracted is so small, this method of fabrication can be used even for high melting point alloys such as stainless steel. The strip still contains enough heat to allow extra passes to be given by rolling mills without reheating.

The process has the outstanding advantage of eliminating the ingot and billet stages in the processing of sheet and strip; this naturally greatly decreases the cost of the product, since the amount of work expended and the scrap losses are much lower.

In developing this method of fabrication, several difficulties were encountered which are now gradually being eliminated. One of the most serious was the edge effect caused by the preferential solidification of the metal on the flanges of the roll; this has been overcome by special methods of pouring the metal into the rolls, such as the recently developed "molten metal end down."

Although the material is cooled rap-

(Continued on page 8)

Nominating Committee Is Appointed; Suggestions for Candidates Welcomed

In accordance with the constitution of the American Society for Metals, President G. B. Waterhouse has selected a nominating committee from the list of candidates submitted by the chapters.

This committee will meet during the third full week in the month of May, and shall name one candidate for each of the following offices:

President	1 year
Vice-President	1 year
Secretary	2 years
Two trustees for	2 years each

The committee will welcome suggestions for candidates. Endorsements of a local executive committee shall be confined to members of its local chapter, but individuals of a chapter may suggest to the nominating committee any candidates they would like to have in office.

Endorsements should be sent in writing to the chairman or other members of the committee at the following addresses:

Emil Gathmann, Gathmann Engineering Co., Baltimore, Md. (Baltimore Chapter), Chairman.

John W. Bolton, Lunkenheimer Co., Cincinnati, Ohio (Cincinnati Chapter).

M. W. Carruthers, Vanadium-Alloys Steel Co., Hospital Trust Bldg., Providence, R. I. (Rhode Island Chapter).

L. C. Conradi, International Business Machines Corp., Endicott, N. Y. (Southern Tier Chapter).

E. O. Dixon, Ladish Drop Forge Co., Cudahy, Wis. (Milwaukee Chapter).

A. O. Schaefer, The Midvale Co., Nicetown, Philadelphia, Pa. (Philadelphia Chapter).

A. G. Zima, International Nickel Co., Inc., 705 Petroleum Securities Bldg., Los Angeles (Los Angeles Chapter).

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RAY T. BAYLESS.....*Editor*
M. R. HYSLOP.....*Managing Editor*

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Gives Exposition of Physical Testing at Bureau of Standards

By H. D. Churchill

Cleveland Chapter was fortunate indeed when L. B. Tuckerman, assistant chief, Division of Mechanics and Sound, National Bureau of Standards, accepted an invitation to address the regular meeting on Jan. 3.

A short coffee talk was given by James H. Herron, founder member of the Cleveland Chapter, who spoke briefly on some of his own investigational experiences in mechanical engineering.

Dr. Tuckerman was then introduced and kept the audience very much awake by a brilliant exposition of physical testing as carried on at the Bureau of Standards.

Dr. Tuckerman gave a brief historical description of the Bureau and its functions. He then went on to point out the necessity for precise work in all phases of testing and illustrated with many slides the methods used at the Bureau to maintain a high degree of precision in all of its equipment.

Many of the special tests and analyses made under his direction on structures for various purposes such as bridges, airships and airplanes were described and illustrated.

Throughout his talk Dr. Tuckerman emphasized the need of theory in understanding and interpreting the results of physical testing, especially when the specimen is of complicated design or irregular shape.

Comment From a Reader

To the Editor:

In the February issue of THE REVIEW there is a report of the last Ontario Chapter meeting given by J. W. McBean. In one of the paragraphs, the following sentence appears:

"Tensile strength of steel is nearly four times that of ordinary castings, modulus of elasticity and fatigue limit are more than twice as great, and ductility is immensely better."

In fairness to the steel casting industry, this statement should be corrected, if by no other way than to insert the word "iron" between "ordinary" and "castings." Steel castings in the 0.20 to 0.30% carbon range will usually show a minimum tensile strength of 70,000 psi.

E. H. MEBS
Ohio Steel Foundry Co.

Two Sciences Were Originated by Sorby

English Inventor One of Five Metallurgical Pioneers Sketched by Waterhouse

By Ray P. Dunn

North West Chapter — Outlining briefly the lives, accomplishments, and contributions of five men, A.S.M. President G. B. Waterhouse of M.I.T. presented his very engrossing talk on "Pioneers" on Jan. 10.

First was Sir Henry Cliffton Sorby of England who made many valuable contributions to various fields of science despite the severe illness which attended him throughout his life. He studied deep-sea life of the South Seas with a microscope, worked with Nichol prisms, examined meteorites, and originated the two great sciences of petrography and metallography. The steel component "sorbite" was named for him.

Sir Henry Bessemer of England, credited with the invention of the bessemer converter, made 114 inventions, one of which was an inexpensive process for making metal powders; from this industry he derived sufficient funds to finance the development of his converter.

The third pioneer was a young, enthusiastic, competent Englishman by the name of Sidney Gilchrist Thomas who developed the basic lining which has proved invaluable to the metallurgical field. He was an excellent example of the so-called self-educated man; his persistent toil to improve his education and his invention resulted in his early death at the age of 34.

P. H. Dudley, who worked for the New York Central Railroad until his death at 80, was noted for his development of the "high T" rail and steel specifications for better rails.

Hermann H. Brassert has done notable work in numerous countries as a metallurgical consulting engineer. One of his most valuable developments concerns the utilization of low grade iron ores at Corby, England. Mr. Brassert and his firm remodeled the old plant with the innovation of metallurgical reduction processes which proved very practicable.

This interesting lecture was followed by Phil Brain's official pictures of the 1937 Minnesota football team.

Streamliners Feature Talk

By Constance B. Brodie

Schenectady Chapter—The February meeting was held at Keeler's Restaurant in Albany.

Joseph Winlock, chief metallurgist of Edw. G. Budd Mfg. Co., was the guest speaker, and chose as his subject "The Metallurgy and Shotwelding of Stainless Steel."

Mr. Winlock's knowledge of the construction of light weight, high speed trains furnished one of the high-lights of the program. The subjects were very thoroughly and interestingly presented as well as illustrated by many lantern slides.

Success in Wire Drawing Depends on Surface Condition of Rod or Wire

By F. A. Pease

New Jersey Chapter—Wire making dates back to biblical times, said E. E. Legge, director of the Physical Research Laboratory of the American Steel & Wire Co., Worcester, Mass., speaking at the January meeting.

It is mentioned in the 39th chapter, 3rd verse of Exodus, and the use of wire drawing dies recorded in Latin manuscript by Theophilus in the 9th Century. Iron wire was first reported to be drawn in Bavaria in the middle of the 15th Century.

The success of wire drawing depends principally upon the condition of the surface of either the rod or process wire. An improperly prepared surface will ruin any subsequent attempts to redeem the quality.

Inhibitors Used in Pickling

Pickling is accomplished successfully with sulphuric acid concentrations of from 2 to 8% at temperatures of 185 to 190° F. The importance of temperature, acid and gravity control were stressed.

Inhibitors are used with sulphuric acid principally to prevent loss of steel and acid. They also aid in reducing pitting and excessive fumes. Sulphuric acid attacks the steel and not the scale; therefore loose scale must be removed by rinsing in a high pressure stream of cold water.

Coating of wire rods with lime neutralizes any remaining acid, and acts as a temporary coating that will not rust. After baking at 300° F. it carries the lubricant into the die.

Selection of drawing lubricants depends upon the number of drafts and finish desired. Grease is generally used for single or double hole drawing. Soap is used for two, three, and four hole drawing. A heavy lime coat is used for four drafts and up.

Although the greatest tonnage of wire is produced by dry drawing, the method of wet drawing is used in the production of smaller sized wires. A drawing solution of rye meal and soap is utilized for a lubricant. Drawing speeds of 3000 r.p.m. are not uncommon in wet copper drawing.

The annealing and heat treatment of wire depend upon the material and its ultimate use.

A noteworthy example is valve springs possessing a bainite structure. This structure is obtained by the direct transformation of austenite between 930 and 300° F. It is microscopically detected by unmistakable characteristics which result in physical properties enhancing to valve spring material.

Normalizing, patenting and spheroidizing were discussed. Process annealing of wire rods in pots at a temperature of 1150° F. is general practice, the full anneal seldom being used with low carbon steels.

Many and varied are the wire products. The swaging, flattening, coiling and hydraulic testing of springs were described and illustrated as well as the fabrication of wire rope, enameling and braiding of wire, weaving of fence, and nail manufacture.

In a photograph of 785 pieces there were no duplicate shapes.

Following refreshments an open discussion of Mr. Legge's interesting talk was led by Chairman C. S. Cronkright.

Pittsburgh Hears Emmons

By G. R. Fitterer

Pittsburgh Chapter — All the tool steel manufacturers in the Pittsburgh district turned out to listen to J. V. Emmons, metallurgist for the Cleveland Twist Drill Co. on Jan. 13.

The speaker generalized for the most part by discussing the various types of high speed steels and the justification for some of the different analyses that are on the market.

His presentation of the consumer's viewpoints concerning some of the desired specifications for these materials was very interesting to the Pittsburgh men and stirred up lively discussion.

Lists 4 Major Improvements In Cast Irons

Harrington Describes Improved Melting, Use of Alloys, Heat Treatment, Special Irons

By R. J. Haigis

Hartford Chapter — Some fear for the success of the February meeting was felt when Sam Spalding, well-known member of the neighboring New Haven Chapter, gave an "interesting" extemporaneous coffee talk on the merits of the New Haven Chapter over the Hartford. It is worthy of note, however, that Mr. Spalding is a frequent attendant at the Hartford Chapter meetings—probably to get ideas and hear good talks.

In a talk on "Cast Iron in the Light of Modern Research" R. F. Harrington, foundry superintendent and chief metallurgist of the Hunt-Spiller Mfg. Corp., Boston, gave the generic definition of cast iron as an iron containing so much carbon that it is not malleable at any temperature. He then proceeded to describe the four major improvements in cast irons, as follows:

1. Improvement in uniformity and quality as a result of improved melting practice.
2. Improvement by the use of alloys.
3. Development and application of heat treatment to cast irons.
4. Development of special purpose irons.

Mr. Harrington then elaborated in turn on each of these items.

Chief Melting Methods

The urge for higher tensile strength demanded the melting of lower carbon iron. The chief methods now in use are the cupola, air furnace, electric furnace, Brackelsburg furnace, and the various duplexing processes.

Nickel, copper, chromium, vanadium, zirconium, titanium and molybdenum are today alloyed alone or in combination with cast irons. The late addition of lowly silicon to the furnace or ladle likewise plays an important part in modern irons. The addition of small quantities of amorphous graphite to the ladle cuts down chill and is still in the development stage, but interesting results are forecast.

Under heat treatment, Mr. Harrington spoke of the relief annealing of castings at 1000° F., the soft annealing, and the quench and draw treatments to arrive at a 300 to 400 Brinell. Hot quenching is a new development on which little data are available.

Special irons described by Mr. Harrington were Ni-Resist, Ni-hard, chilled cast Ni-Hard, Invar iron, rust and heat resisting irons, and nitricastiron.

Foundry Practice All-Important

In closing, Mr. Harrington stressed the fact that even with all the new special irons now available, an iron or a casting is only as good as the practice behind it. Foundry practice is directly reflected in the quality and properties of the finished casting.

High test iron goes back much further than many authorities indicate. The old South Boston Iron Works, of which the Hunt-Spiller Mfg. Corp. is a successor, in 1850 produced an iron from air furnaces which had a tensile strength in excess of 45,000 psi.

Among other things brought out in the question period was the fact that the word "semi-steel" is a misnomer and has no meaning whatsoever. Cast irons should be thought of in terms of physical properties rather than chemical. Wear resistance of cast irons was discussed at length.

Harris and Bain Share Honors in Attracting Capacity Crowd

Judging by Dr. Bain's Smile Harry Harris Must Be Telling a Good Story. This is an unusual picture because for once Mr. Harris is in front of the camera lens instead of behind it or hanging on to a "stick." From left to right are H. H. Lester, chairman of the Boston Chapter; United States Steel Corp.'s E. C. Bain; H. H. Harris, president of General Alloys Co.; Albert Sauveur of Harvard University; A.S.M. National President G. B. Waterhouse of M.I.T.; and H. E. Handy, Boston secretary. A. L. Knight was the alert cameraman as well as chairman of the Program Committee which arranged this meeting.

Standing Room Only Sign Hung Out for Harris's Photography, Bain's S Curve

By Alex Hayner

Boston Chapter—The honors for a record-breaking attendance on Feb. 4 were divided between H. H. Harris, coffee talker, and E. C. Bain, technical speaker.

The advance notices carried information that Mr. Harris's subject would be "not entirely about alloys" and needless to say, his talk was ably supplemented by pictures that at times digressed markedly from alloys but kept his audience at a high pitch of interest.

His aerial photography is exceptional as to subject, beauty and expertness of camera work. Coupled with such artistic pictures as that of the America Cup defender, *Ranger*, taken while soloing through the clouds, were many common-sense pictures of heat and corrosion resisting alloys, with constructive comments by Mr. Harris.

The "Standing Room Only" sign was out at one of the largest auditoriums of Massachusetts Institute of Technology where Dr. Bain gave his famous lecture on "Some Anomalies in the Heat Treatment of Steel." Dr. Bain's popularity as a technical speaker was attested by his large audience including A.S.M. members from each of the six New England states, many of whom had traveled long distances to listen to his talk.

Following the meeting there was a lively and constructive discussion, mostly on the famous S curve.

Part Played by Economics of Tungsten Situation in High Speed Steel Shown

Philadelphia Chapter — Norman I. Stotz, metallurgical engineer of Universal-Cyclops Co., occupied the speaker's platform at the regular meeting held on Jan. 7.

Mr. Stotz gave an informal talk full of valuable and interesting information. He briefly reviewed the classes of high speed steels, then described modern trends of composition and heat treatment and discussed their relative position in the field of cutting tools with stellite, cemented carbides and age hardening materials.

He talked on the economics of the tungsten situation, explained how it is priced and sold, and indicated that at current prices an adequate supply exists in the United States to take care of any normal demand in the near future. In frankly discussing the part tungsten scrap plays in the production of high speed steels he pointed out the difficulty of producing tungsten-free molybdenum high speed steels on a large scale.

Valuable New Treatment Described

The surface treatment of high speed steels in the cyanide type of salts, which causes an apparent concentration of fine carbides in the outside skin, was described as a valuable new treatment.

The practice of double tempering was also recommended, especially carrying out the second tempering at a slightly higher temperature when maximum toughness is desired.

After discussing the trend in heat treating the molybdenum steels, the other types of cutting materials were described and their very useful applications in the non-ferrous, plastic, paper, asbestos and cast iron fields were indicated.

Constant study is increasing their usefulness in the cutting of steel. The speaker emphasized that we often lose sight of the fact that these materials not only increase standard cutting efficiencies but also cut many materials that are so hard they formerly were shaped only by grinding.

At the dinner preceding the meeting, Mr. Tippin of the Bell Telephone System of Pennsylvania spoke on the subject, "As The Telephone Grows." Mr. Tippin exhibited many of the old type telephone gadgets, which were large, costly and cumbersome, and then showed similar gadgets of today, which are more efficient and cost less to manufacture and install.

Forging History Traced

One hundred years in the forging business are traced in an extremely interesting book recently issued by the Kropp Forge Co.

Starting in 1928 in a little water-wheel-operated single hammer plant, the story of the company's progress is carried through to the dedication of a new machine shop late in 1937. The book is profusely illustrated with pictures of old and modern times, and interesting comparisons are drawn.

Forging users are invited to write for this book, addressing Kropp Forge Co., 5301 W. Roosevelt Rd., Chicago. The issue is limited, and only one copy is available to any one company.

E. E. Thum Diverts From Main Theme to Discuss Labor Versus Machines

By G. R. Fitterer

Pittsburgh Chapter—E. E. Thum, editor of METAL PROGRESS, outlined some of the trends in metallurgical control at the meeting on Feb. 10. He purposely diverted from this main theme, however, to discuss a phase of the linkage between metallurgical control, management and labor.

Mr. Thum laid a large portion of the blame for the unemployment problem to technological ("labor saving") machinery. He seemed to feel that each industry would be less eager to install such equipment if labor as well as machinery were properly amortized on the balance sheet—that is, if proper provision were to be made in advance for the labor made obsolete by new machinery. Since industry has not made such provision, he said it is only natural that Government should do it, in the form of relief, job insurance and old age pensions.

These are frequently local problems and industries should keep in mind the future of the communities that they originated and not force their obsolete labor on either their own or other communities.

Lively discussion followed his talk and ranged from this problem of technological unemployment to a discussion of the "reclamation" of the beauties of the Pittsburgh district.

One important question was left unanswered—whether the source of finance that will care for such obsolete labor could be better provided in advance by industry as a normal cost, or extracted from industry at a later date in taxes.

Two Local Speakers Ably Cover Salt Baths

By Ralph D. Hawkins

New Haven Chapter—The January meeting was devoted to the subject of "Salt Baths" and was addressed by two speakers, both prominent in local industries as well as Chapter activities.

The first talk was presented by Haig Solakian, director of research, A. F. Holden Co., and covered the desired chemical and physical properties of various types of salt baths for tempering, annealing and hardening of steels.

Dr. Solakian gave several suggestions for obtaining best results with the use of salt baths. He also described the properties and the uses of two special baths for high speed steels, one for hardening without pitting, scale or soft skin, and the other for the secondary treatment after the tool is hardened, tempered and finish ground.

This secondary treatment renders the surface of the tool extremely hard and resistant to wear.

Considerable interest was shown in the comparative life of pressed steel, alloy and refractory pots recently developed by the Holden Co.

Samples of high speed steel hardened in the salt bath were exhibited to illustrate the type of surface obtained.

Lloyd E. Raymond, metallurgist of the Singer Mfg. Co of Bridgeport, Conn., then talked on "Case Hardening Salts." He discussed desirable chemical composition, temperature range with relation to type of case, equilibrium of case analysis with reference to bath and temperature, and type of case obtained with low and high temperatures.

The relative merits and fields of the activated baths, and the sodium cyanide bath were covered. Considerable discussion was evoked by the speaker's statement that a 0.070-in. case may readily be obtained with a sodium cyanide bath.

Equipment for Heat Treatment Of Four Types

Heat Treaters, Now Atmosphere Conscious, Use Mostly Salt Baths, Controlled Gas and Electric Furnaces

By Walter M. Saunders, Jr.

Rhode Island Chapter — "Modern Equipment Used for the Heat Treatment of High Speed Steel" was the subject discussed by J. P. Gill, chief metallurgist of the Vanadium-Alloys Steel Co., on Feb. 2.

Without expressing any personal preferences, Mr. Gill described the four types of equipment used, namely, the old semi-muffle type of gas furnace, salt baths, and atmospherically controlled furnaces, both electric and gas.

The semi-muffle type of furnace has been superseded almost completely by the last three, chiefly because steel treaters have become atmosphere conscious. Atmospheric control can be realized either by burning gas, or by introducing carbonaceous material into the furnace.

Local Firms Credited

Due credit was given to Carl Hayes of the C. I. Hayes Co., Providence, one of the Chapter's sustaining members, as the pioneer in atmospheric control. Another local firm, the Sentry Co., received the speaker's compliments.

While salt baths give excellent results, their maintenance is considered expensive by the speaker, and only recently have difficulties in quenching been overcome by the use of a suitable salt quenching bath.

In Mr. Gill's opinion, there are three types of furnaces that can rightly be called atmospherically controlled—the ones electrically heated by globars, those electrically heated by metallic resistors, and the full muffle gas-fired type. The full muffle type is probably least expensive, although the electrically heated furnaces have much to recommend them.

Mr. Gill mentioned a very recent type of electric heating element (described in METAL PROGRESS, February 1938, p. 136). This unit consists of a molybdenum wire coated with glass and enclosed in sillimanite, and appears very promising.

Atmospheres Difficult to Maintain

Controlled atmospheres are difficult to maintain for the following reasons: *(a)* Products of combustion react with raw gas, or *(b)* with muffle and work in the furnace; *(c)* raw gas varies in moisture content from day to day; *(d)* commercial gases are not constant in composition; *(e)* a set of conditions which exists at one temperature will not hold true at another temperature.

Mr. Gill brought out that while it has been claimed that high speed steel may be hardened at 1850° F., in a carburizing atmosphere, the true story is that hardness is merely superficial and is produced solely by carburization of the surface of the high speed steel to as high as 1.7% carbon, starting with the usual 0.70%.

The talk was enlivened considerably by Vice-Chairman Merle Caruthers, who was given the job of running the lantern. After much research, he established that there are an infinite number of positions in which a slide may be inserted in the lantern. Mr. Gill, however, claimed four possible ways, and only one correct one, unless the members of the audience stood on their heads or read from right to left.

Renaissance of Industry Sees Ni Development

Application of Nickel Steels Was Interesting Phase of Post-War Metallurgical Development

By James R. Patterson

Los Angeles Chapter—National Secretary William H. Eisenman was a guest at the January meeting. He spoke briefly regarding the forthcoming Western Metal Congress and Exposition, and regarding the activities on his "farm."

As a prelude to a paper on "Applications of Nickel Alloy Steels in Petroleum Production," the speaker for the evening, Albert G. Zima, Development & Research Division, International Nickel Company, discussed briefly the history of nickel.

Discussion Confined to 5% Nickel

Soon after the World War, industry as a whole became discontented with old standards and practices, and there began an era of metallurgical development never before experienced in the history of mankind. The development of nickel alloy steels and their application to industry constitute one of the interesting phases of this "Renaissance."

Mr. Zima's discussion was confined chiefly to the pearlitic steels containing up to 5% nickel and not over 0.50% carbon. These steels, compared with plain carbon steels of equivalent strength, possess a higher fatigue ratio, notch toughness, and better ductility. Compared on the basis of equal ductility, they possess considerably higher tensile strength and yield point.

The fundamentals from which the properties of nickel alloy steels are derived were enumerated as follows:

Four Fundamental Properties

1. Nickel dissolves in all proportions in both gamma and alpha iron. Above the critical range it remains dissolved in gamma iron and below the critical range in alpha iron.

Since solid solutions frequently possess a higher hardness than do their components, and since nickel is soluble in iron in all proportions, it hardens steel, not by carbide formation, but by action upon the ferrite.

2. Nickel lowers the transformation points or critical range of steel, thus permitting lower quenching.

3. Nickel retards the rate of reaction through the transformation range, thereby permitting mild quenching and depth hardening.

4. Nickel refines the structure of the ferrite, resulting in high impact and fatigue resistance. The ability of nickel to promote resistance to grain growth upon heating above the critical temperature is an important factor in selecting steel for case hardening.

2.75% Ni Steels for Forgings

The low carbon 2.75% nickel steels were emphasized as being particularly adapted to forgings and other parts subjected to localized stresses. The ability of these steels to redistribute stresses and thus minimize dangers from fatigue and impact failures was discussed in detail.

The recently developed nickel-copper steels, in addition to their resistance to corrosion fatigue and mild types of corrosion, possess excellent mechanical properties and are readily welded.

In conclusion, the importance of careful design was emphasized as a factor in the satisfactory performance of oil field equipment.

Bike Racers Beware When A.S.M. Meets!

The A.S.M. Subcommittee on Carburizing under the leadership of Bob Schenck of Buick walked off with the laurels and successfully completed a metallurgical endurance contest that will go down in A.S.M. history.

The Committee convened at 9 a.m. at the Statler Hotel in Detroit to prepare a new section on carburizing for A.S.M. Metals Handbook. Chairman R. B. Schenck, Ernie Davis, Harry McQuaid, John Dow, Gordon Williams and J. E. Donnellan were present. R. W. Schlumpf and R. G. Guthrie, also members of the Committee, were unable to attend.

As the metallurgical dissertation progressed the members became "case hardened" to all human sensations to such a "depth" that the subject of food or refreshments, generally a weighty problem, did not creep into the discussion.

The deliberations continued uninterrupted with the exception of the usual metallurgical pros and cons until 11 p. m., when the Committee members, metallurgically punch drunk, finally called a halt to the record-breaking 14-hr. session and wended their weary way to the hotel commissary for much needed sustenance and refreshments.

When longer committee meetings are held, the Carburizing Committee will hold them!

Broadness and Complexity Of Carburizing Limit Talk

By Ray P. Dunn

North West Chapter—"Carburizing" was the subject of the talk given by Robert G. Guthrie, consulting metallurgist of Chicago and past president A.S.M., on Feb. 8.

Because of the broadness of the subject and the complexities involved in carburizing, it was necessary for the speaker to limit his talk to an outline of the historical developments, principles, and primary precautions to be observed. Mr. Guthrie also discussed the value and feasibility of carburizing various types of steel.

During the question and answer session after his interesting speech Mr. Guthrie stated that the results of his research in gas carburizing disclosed the following facts: That soot retards the rate of carburization, and that furnace atmosphere control at the exhaust outlet gives better control than at the inlet alone.

The program was completed with the showing of the U. S. Steel Corp.'s sound picture, "The San Francisco-Oakland Bay Bridge."

Copper Properties Outlined

(Continued from page 1)

the mines is converted into 99.96% pure copper.

Briefly, the anodes dissolve in the sulphuric acid electrolyte, pure copper plates out on a pure copper starting sheet, soluble impurities stay in solution and the other impurities including gold, silver, selenium and telurium, go to the bottom of the cell as a mud or "slime." The slime is roasted with sulphuric acid driving off most of the selenium, then leached with water which dissolves most of the contained copper. A caustic leach next removes most of the telurium.

The residue is then furnace refined, producing a "dore" bullion that is mostly gold and silver. This bullion is electrolyzed in nitric acid, producing pure cathode silver and a gold residue, both of which are melted into bars.

Selenium and telurium, each 99.5% pure, are now turned out as byproducts and a considerable number of uses have already been found for them. Selenium, the chief of these byproducts, is used in glass coloring, rubber, steel, medicine, photo-electric cells, and other products.

Five Chapters to Meet

Five Pennsylvania chapters and the Southern Tier Chapter of the A.S.M. will join for the third time in an interchapter meeting at State College, Pa., Friday and Saturday, May 20 and 21.

The participating chapters are Pittsburgh, Philadelphia, Lehigh Valley, York, Penn State and Southern Tier.

Technical sessions will be held on Friday afternoon and Saturday morning. An informal dinner and entertainment at the Nittany Lion Inn will occupy Friday evening. Ladies will be welcome, and special provision will be made for their entertainment.

Details of the technical program will be announced in the next issue of THE REVIEW.

Cleveland Chapter Has Republic Day, Visits New Strip Mill

By H. D. Churchill

Cleveland Chapter—March 7 was "Republic Day." In the afternoon an inspection trip was made through the new 98-in. continuous strip mill of the Republic Steel Corp.

Interest in this new mill was high and attendance was estimated at close to 1,000. That this interest was warranted may be established by the following facts.

On what one year ago was swamp land along the Cuyahoga River, Republic Steel Corp. has completed and placed in operation within the last few weeks the world's widest and most modern continuous hot and cold strip mills.

Annual capacity is 1,000,000 tons. Complete time for building was 10 months, 8 days. The hot mill building is one-third mile long. Capacity of the hot mills is 75,000 tons per month; cold mills, 30,000 tons per month. Steel strip can be rolled at speeds up to 2120 ft. per min.

Ten 98-In. Stands in Hot Mill

Ten massive stands in tandem comprise the 98-in. hot mill; the cold mill consists of three huge 98-in. stands in tandem and two single 98-in. stands for temper rolling and surface finishing.

These powerful units, combined with the most modern pickling, annealing, shearing and other finishing equipment, afford a greatly enlarged output of large and small sheets, light plate, and coiled strip, with unusual uniformity and accuracy in temper, ductility, surface finish, gage and physical properties.

Dinner was held at the Cleveland Club at 6:30. After seeing the very latest developments in the finishing of steel in the afternoon, an evening address by Harry Craig Richardson of Republic on "Historical Steel Making" was just the added touch necessary to make the day a tremendous success.

Mr. Richardson spoke at length on the production and use of steels as carried out in ancient times and illustrated his points by many slides. His talk was extremely interesting and those who heard him are looking forward to his book on this subject, now in the making.

Carbide Tools And Powdered Metal Featured

Film on Carbide Cutting Tools Replaces Coffee Talk and Precedes Comstock's Discussion

By L. H. Grenell

Dayton Chapter—Instead of a coffee talk at the January meeting, a short movie on carbide cutting tools was shown in conjunction with the main talk on "Powder Metallurgy" by G. J. Comstock of Handy and Harman.

An outline of the history of powder metallurgy was presented, beginning with the production of ductile tungsten wire by Coolidge and Benbow for lamp filaments. This tungsten wire required unusually hard drawing dies, and hard cemented carbide was developed to replace the use of gems.

The possibilities of the carbide material as a cutting tool were recognized by Krupp, who first marketed carbide tools.

For certain resistance welding operations, a material with good wearing properties and high electrical conductivity was required, and a combination of copper and tungsten powder known as Elkaloy was produced.

Bearings Are Early Product

The development of powdered metal bearings and electrical contacts was also associated with these early products and awakened wide interest in the possibilities for other applications.

Powder metallurgy possesses two general advantages over other methods of manufacture:

1. It permits the use of materials which have no other practical methods of production, obtaining new and unusual combinations of properties.

2. It has economic advantages in the fabrication of metal articles without the use of melting and casting, often eliminating machine and grinding operations as well.

The versatility of powder metallurgy is shown by the fact that it is possible to obtain metal combinations which do not alloy, which alloy slightly, or which form a molten constituent during heat treatment; combinations in which the original properties of one constituent are maintained (cemented carbides), in which the original properties of all constituents are maintained (electrical contacts); where the elimination of cast structure is desirable; where regulated porosity is desired (oilless bearings); where finishing operations should be eliminated, segregated compositions are desired, close tolerances are desired, and where absence of extraneous material is essential.

Disadvantages Named

On the other hand, the process has certain inherent disadvantages—namely, the production of satisfactory metal powders at a price to permit commercial application; difficulties in controlling particle sizes of powder to close limits; necessity of special molds and heavy presses involving high equipment cost; present lack of knowledge concerning the mechanics of the welding, adhesion and dispersion of the component particles; and difficulties in manipulation, such as exclusion of air.

Following Mr. Comstock's discussion, Pierce T. Wetter of American Cutting Alloys, Inc., showed a film depicting the preparation of hard cemented carbides, the manufacture, testing, grinding and proper use of carbide tools.

A discussion followed, which dealt largely with the use of carbide tools, including points concerning brazing, grinding and application.

HERE AND THERE WITH A.S.M. MEMBERS

Robert Sergeson

THE new chief metallurgist of Crucible Steel Co. of America's Park Works, Pittsburgh, brings a wide and varied experience in the production and use of stainless and alloy steels. He is ROBERT SERGESON, who has been with Republic Steel Corp. and its predecessors, Central Alloy Steel Co. and Central Steel Co., since his graduation from University of Pennsylvania in 1922. For the past 8 years he was director of the metallurgical laboratory for the Canton and Massillon plants of Republic Steel Corp.

Among his well-known technical contributions are papers on nitriding and stainless steels, and on low temperature impact properties. The A.S.M. Metals Handbook carries his name among its authors.

Bob was also instrumental in the formation of the Canton-Massillon Chapter of the Society, served as its first secretary, and in 1932 as chairman of the Chapter.

DECIDING that a B.S. degree had too many limitations and that the best means of obtaining a higher education would be to become affiliated with some large school, W. H. RICE of Cleveland recently secured an appointment to teach welding and metallurgy at Oklahoma Agricultural and Mechanical College.

Rice has been with Wellman Engineering Co., Cleveland, since graduation from Case School of Applied Science in 1935.

In addition to teaching, he is working toward a Master's degree in industrial engineering, organizing a student branch of the American Welding Society, designing a larger and better equipped welding laboratory, and planning some research work in impact and fatigue.

His official position is instructor, industrial arts education.

JOHN EMIL DORN has been appointed professor of mechanical engineering at University of California. Only 29 years old, Dr. Dorn holds a Ph.D. degree in physical chemistry from the University of Minnesota and stands as author of an imposing list of technical publications. He has spent the last two years as research associate at Battelle Memorial Institute in the Department of Physical Metallurgy.

* * *

ANTHONY J. HILDENBRAND, purchasing agent, Cincinnati Milling Machine Co., died Feb. 20 after a brief illness. Hildenbrand, who was 41, had been associated with Cincinnati Milling Machine Co. for 26 years. He was an active member of the Cincinnati Chapter, and was largely responsible for the arrangements and success of the last Tri-Chapter meeting in Cincinnati.

J. A. Comstock

INVESTIGATION and development of metallurgical processes utilizing furnace atmospheres will constitute the duties of J. A. COMSTOCK in his new position as consulting metallurgist for Surface Combustion Corp., Toledo, Ohio.

Mr. Comstock, who faithfully served the Chicago Chapter for seven years as secretary and treasurer, is a graduate in metallurgy from University of Illinois. For nine years he did research work for Peoples Gas Light and Coke Co., and for the past 4½ years has been metallurgist at Illinois Tool Works.

He is the author of numerous articles on carburizing and heat treating, and a recent three-month European junket investigating metallurgical developments should add to his fund of information on these subjects.

Tool Steel Failures Are Illustrated by Slides and Samples

By M. J. Donachie

Springfield Chapter — The speaker for Sustaining Members' Night, Jan. 17, was W. R. Frazer of Union Twist Drill Co., Athol, Mass. The subject was "Metallurgical Control in the Manufacture of High Speed Tools."

The speaker launched his talk with a summary of the essential factors governing control procedure. The quality of the tool due to the chemical analysis and physical make-up of the raw stock, and methods of checking the material for these properties, were discussed and illustrated by slides, and actual sample specimens were shown to emphasize certain characteristics.

Routine inspection, supervision of heat treatment and ample physical test check-ups were dwelt upon by the speaker and the metallurgical aspect of the problem correlated with the test results. The investigation of failures and the knowledge to be gained by such study was the subject of special attention.

Slides and sample specimens showed some failures and—what was most interesting to the audience—the reason why they failed.

The superior qualities of today's tools over those of some years ago were attributed to a number of factors, chief among these being the progress in steel making and a better understanding of the tool applications and the metallurgical behavior.

The speaker then discussed the research angle and defined its place and advantages in the application of metallurgical control.

Age Hardening Forms Subject of Feb. Seminar

By David R. Howerton

Chicago Chapter—A comprehensive and interesting discussion of age hardening phenomena in metals constituted the Feb. 17th Seminar Program.

The Seminar Committee obtained as discussion leader Dr. Arthur B. Wilder, assistant professor of metallurgical engineering, University of Illinois, who has a vast knowledge of the subject.

The meeting was fashioned to a considerable extent after the previous meeting of the seminar series on physics of metals which proved to be such a success.

During the first 40 min. of the meeting the discussion leader presented the subject material in a simple, fundamental manner. Following this, questions were submitted by each attendant. These were separated and all similar questions grouped together. Then with participating discussion from the leader and the group, the subject was thoroughly covered.

Movies to Replace Formal Educational Lecture Series

By J. W. McBean

Ontario Chapter—Some changes from the program of former years were announced at the February meeting.

Instead of a formal series of educational lectures, one evening will be devoted to a film on steel and one to a film on copper, which will be shown on different evenings in Hamilton and Toronto, and limited to members.

The famous annual field day will also be limited this year to members.

The guest speaker was R. L. Kenyon, research metallurgist for the American Rolling Mill Co., who gave his talk on "Sheets for Deep Drawing," previously presented to some of the other A.S.M. chapters.

The talk was followed by a movie film showing the building of the framework of the new 200-in. telescope to be installed on top of Mount Palomar in California.

Hardenability Tests Given

(Continued from page 1)

burizing box in production, the test bar is carburized and cooled from the carburizing box on the test fixture. If the steel is a medium carbon steel to be heated to 1500° F. and quenched, then the test bar is heated to 1500° F. and cooled on the fixture.

A number of steels have been tested and curves of the hardenability characteristics of about 30 different steels were presented.

Of the carburizing steels tested, S.A.E. 4815, carburized, had the greatest capacity for hardening. Of the medium carbon steels tested, S.A.E. 4340 had the deepest hardening characteristic.

Peoria Course on Forging

Peoria Chapter opened its fifth series of educational courses on March 7 with a general lecture on forging practice by Adam M. Steever of Columbia Tool Steel Co.

The four succeeding lectures in the course are scheduled March 21, March 28, April 4 and April 18 in the Central Illinois Light Co. Auditorium.

The subject of the course, "Manufacture of Steel Forgings," is a popular choice because of the wide use of forgings in daily life and also because of the lack of forging plants in the Peoria district.

Other lecturers in the series are J. N. Harris, Rockford Drop Forge Co.; E. O. Dixon, Ladish Drop Forge Co.; A. R. Nettenstrom, American Forge Division of American Brake Shoe & Foundry Co.; and Harold F. Wood of Wyman Gordon Co.

Employment Service Bureau

Address answers care A. S. M., 7016 Euclid Ave., Cleveland, unless otherwise stated

Positions Open

RAPIDLY DEVELOPING PLANT in middle west desires metallurgist with good technical background and practical experience in hardening large parts of deep section in high carbon alloy steel. Opportunity for right man to develop present small research facilities into sizable organization. Box 3-5.

GRADUATE CHEMIST (23 to 30 years of age) for technical service work in process industries. Must have personality and adaptability for sales service work. Box 2-5.

Positions Wanted

MECHANICAL ENGINEER: B.S. in engineering, 1935, and one year of graduate work at University of Michigan. Experience in production work in stove company and development engineering in gas welding and cutting of metals. Age 25. Box 3-10.

METALLURGIST: Chemical engineering graduate. Two years experience in metallography and corrosion problems. Additional experience in routine chemical analyses and electroplating. Box 3-15.

SALES AND SERVICE EXECUTIVE: Metallurgical engineer, steel mill trained. Five years experience in sales and servicing of steel and allied products; nine years aggressive managing technical sales and service and directing introduction, marketing, and practical research of chromium-nickel alloys and heavy chemicals to steel mills, foundries, drop forging, automobile and general steel consuming industries. Box 3-20.

PHYSICAL CHEMIST AND METALLURGIST: Ph.D. in physical chemistry and metallurgy. Four years experience in industrial research; six years experience teaching metallurgy in engineering schools. Will consider either industrial or teaching position. Box 3-25.

METALLOGRAPHER: B.S. in Mechanical Engineering, 1932. Two years experience as metallographer, and two years in machine shop and production work. Particularly interested in machine shop problems but would welcome any metallurgical control or research laboratory work. Box 3-30.

METALLURGIST: Engineer of Metallurgy degree from Colorado School of Mines, 1937. Has taken training course with large steel company. At present working for construction company but would like to get back into metallurgy. Box 3-35.

CLERICAL POSITION wanted in steel plant. One year University of Illinois, general business course. Six months as inspector in billet mill; three months as temperature recorder in metallurgical laboratory. Age 19. Box 3-40.

YOUNG MAN: 23 years old, interested in any type of work connected with gas furnaces. Has had two years of college and 3½ years experience in construction, research, and engineering and service on gas furnaces of various types. Locality of work not important. Box 3-45.

METALLURGICAL ENGINEER (British nationality and residence) having complete knowledge and over 20 years' experience in metallurgical plant operations, ferrous and non-ferrous, desires to negotiate with interested parties in U.S.A. and Canada. Processes recently required suitable to abovementioned market. Alternatively, prepared to take up position in above countries or act independently for interested parties in British market. Box 2-20.

METALLURGIST: B.S. Missouri School of Mines, 1933; age 27. 2½ years experience in laboratory, casting and fabrication of brass, bronze, and nickel silver; 1 year experience in forging, pressing, forming, and heat treating of steel; ½ year experience in high speed tools; work with controlled atmosphere and gas analysis. Available immediately; any location. Box 3-50.

METALLURGIST: B. Met. E., M.Sc. Six years experience as metallurgical assistant and routine chemist in steel tube plant; four years non-technical business experience. Desires connection with plant that processes steel tubing for automotive use. Cleveland district preferred but not essential. Age 35. Available June 15. Box 3-55.

METALLURGIST: 35, with ability to inspire study and organize and direct research, desires to enter educational field. Doctorate in metallurgy from recognized school; eight years varied industrial experience. Publications; excellent references. Box 3-60.

Free Literature — Mail Coupon Below

Hardener's Pal
J. Milton Luers, Detroit, Mich., has just perfected the 'Ste-Tre-Meter', an accurate timer for steel treatment. It's an invaluable aid to the steel treater and will save thousands of dollars in eliminating burnt or soft steel. Write for attractive folder giving full details. Bulletin Db-194.

For the Laboratory
Fisher Scientific Co.'s new catalog on Castaloy laboratory appliances is well arranged and informative. It covers the complete line of clamps and frames for all laboratory purposes made of this high strength corrosion resisting material. Bulletin Db-182.

Handling Oil
Quenching oil equipment is described in a bulletin by M. K. Epstein Co. Data demonstrating how such an installation cools and circulates the oil in minimum space and with minimum cost are given. Bulletin R-174.

Stressproof Steels
La Salle himself decorates the attractive cover of La Salle Steel Co.'s booklet on the stressproofing process for producing cold finished steel bars of both high strength and free machinability. Bulletin R-175.

Insulating Concrete
A treatise on the properties and uses of light weight insulating concrete as applied to roof and floor construction contains a wealth of useful information. F. E. Schundler & Co., Inc. Bulletin R-176.

Phototube
C. J. Tagliabue Mfg. Co. has a new 28-page pyrometer catalog, which describes and illustrates many unique features of Tag Celectray indicating, recording and controlling pyrometers and resistance thermometers. Bulletin Bb-62.

Pen-Kay
A photographic portfolio shows that Pen-Kay carburizer is a case hardening bath that lives up to its claims. Producing a high carbon case, it is a single substance, soluble in water, versatile, and economical. Heatbath Corp. Bulletin Cb-189.

Hand Tools
The use of nickel alloy steels for hand tools and small power tools is described in a 15-page technical bulletin by International Nickel Co. Curves and tables show compactly the properties of the various alloys. Bulletin Cb-45.

Measuring
A cloth-bound, 127-page book is used by Carl Zeiss, Inc., to catalog the industrial measuring and gaging instruments made by the company. Uses, working range and accuracy of measurement are concisely and clearly stated, and many illustrations are used. Bulletin Cb-28.

Metallographic Catalog
Constant refinement and improvement necessitates frequent revision of Bausch & Lomb Optical Co.'s catalog of metallographic equipment and accessories. The latest issue has 32 pages, both detailed and tabular descriptions, and ample illustration. Bulletin Cb-35.

Free-Vane Controller
A new control instrument, with wide throttling range and automatic reset that provides for point-control, is now being built by the Bristol Co. Special features of this controller are given in Bulletin Cb-87.

Globar Elements
Globar electrical heating units and a variety of accessories for their operation have been catalogued by Globar Division of Carborundum Co. Bulletin Oy-25.

Heat Resisting
A striking booklet by Driver-Harris Co. has some interesting information and photographs of heat resisting alloys for heat resisting applications. The company makes a wide variety of parts from Nichrome, Chromax and Cimet. Bulletin Cb-19.

Insulating Brick
The important advantages of Insulbrix, made by Quigley Co., are fuel, time and labor saving, increased production, higher efficiencies, and lower operating costs. How these advantages operate is told in Bulletin Cb-139.

Conveyor Rolls
The record made by Calite alloy furnace conveyor rolls in a large steel mill having unusually heavy hearth loading is told in a leaflet by the Calorizing Co. Bulletin Ka-26.

Pyrasteel
All types of uses for Pyrasteel, the heat resisting alloy made by Chicago Steel Foundry Co., from astronomical plaques ruled 20,000 lines to the inch to huge kilns, are described in an illustrated pamphlet. Bulletin Cb-184.

Fleetweld
"Fleetweld" is only one of the 21 electrodes made by Lincoln Electric Co. for various welding and hard facing needs that are described in a new bulletin. Procedures and weld properties are given. Bulletin Cb-10.

Flux
A short, informative bulletin covering the low melting temperature, rapid solvent action and wide temperature range of Handy Flux—which speeds up and improves brazing operations. Handy & Harman. Bulletin Oy-126.

Tool Steel Selector
A wall chart, 30 x 20 in., to be used as a means for selecting the proper type of tool steel is offered by Carpenter Steel Co. to tool steel users in the U.S.A. only. Bulletin Jz-12.

Drop Stamping
A brand new forming machine known as the "Cecostamp" is being placed in production by Chambersburg Engineering Co., which successfully copes with the latest advances in sheet metal working technique. Details in Bulletin La-132.

Carburizer
Modern is the furnace and modern is the catalog which describes it. Hevi Duty Electric Co. has an exceptionally well-written, well-illustrated, and artistically printed booklet on the Hevi Duty carburizer which uses the Carbonol process. Bulletin La-44.

Rockwell Tester
A revised and completely up-to-date catalog on the well-known Rockwell hardness tester is well illustrated and contains 24 pages. Published by Wilson Mechanical Instrument Co., Inc. Bulletin Ca-22.

Heat Resisting Alloys
Authoritative information on alloy castings, especially the chromium-nickel and straight chromium alloys manufactured by General Alloys Co. to resist corrosion and high temperatures, is contained in Bulletin D-17.

Moly Cast Iron
The use of molybdenum in foundry practice, both on steel and cast iron, is described in a handsome booklet by Climax Molybdenum Co., which presents accurate technical information in a striking and modern manner. Bulletin Jy-4.

Spoilage Insurance
C. I. Hayes, Inc., has compiled a record of reports from over 300 users of their "Certain Curtain" controlled atmosphere furnaces showing how these furnaces have cut down spoilage in the heat treatment of tools. Bulletin Sx-15.

Flowmeters
Flowmeters patented by American Gas Furnace Co. measure the entire flow of air or gas, thus permitting exact control of gas burning operations and carburizing. The principle, installation and uses are described in Bulletin Ha-11.

Explosion Protection
A gas burner safety device designed to prevent explosion made by Wheelco Instruments Co. is known as the Flame-otrol. Illustrations, data, operating diagrams and prices are fully covered in Bulletin Ia-110.

Riveting Aluminum
The riveting of aluminum and its alloys is treated from all angles in a comprehensive little booklet by the Aluminum Co. of America. Materials, types, riveting practice for various applications, and properties of the riveted joint are covered. Bulletin Da-54.

Turbo-Compressors
Spencer Turbine Co. has turbo-compressors in all sizes and types for oil and gas-fired furnaces, ovens and foundry cupolas. Special types for special purposes such as gas-tight and corrosion resisting applications are also described in Bulletin Da-70.

Bright Annealing
Electric Furnace Co. tells about their controlled atmosphere furnaces for continuous deoxidized annealing, bright normalizing and annealing ferrous and non-ferrous metals. Work comes clean, bright and dry from these furnaces. Bulletin No-30.

Vapocarb-Hump
Vapocarb-Hump, the triple-control method for heat treatment of steel, is described in a 36-page catalog issued by Leeds & Northrup Co., in which a special effort has been made to show how this method gives complete control of tool surface, shape and structure. Bulletin Cb-46.

Welding Instructions
Primarily concerned with methods of showing welding on drawings by the American Welding Society's new symbol system, an attractively bound 81-page booklet entitled "Welding Instructions and Standards, Part I" has been published by the United States Steel Corp. Subsidiaries. Bulletin Cb-79.

Sandblast Gun
A four-page pamphlet describes and illustrates the sandblast gun made by Michiana Products Corp. Besides descriptive details, a series of photographs show various operations, and photomicrographs show the smooth, uninjured finish of surfaces cleaned with this gun. Bulletin Cb-81.

Potentiometer Type
Potentiometer type pyrometers, indicating, recording and controlling, are catalogued in a 48-page booklet by Brown Instrument Co., well printed in three colors. Includes the new Electr-o-Line controllers and the Brown proportioning control system. Bulletin La-3.

Tubulaire
A new method of electric heating which combines circulation, greater radiating surface, and great strength is embodied in tubular resistor elements. Description, specifications and illustrations for the type made by Lindberg Engineering Co. are contained in Bulletin Cb-66.

Rustless Handbook
Offered as an answer to the question, "Which stainless steel?" a 60-page handbook by Rustless Iron and Steel Corp. gives complete information on properties, processing, and engineering applications of a wide variety of rustless and stainless steels. Excellently arranged, printed and illustrated. Bulletin Bb-169.

Hard Facts
A new four-page monthly is being published by Wilcox-Rich Division of Eaton Mfg. Co. to tell you how Wilcox-Rich products are serving industry. Many articles and interesting data on the hard surfacing material, Xaloy, are contained. Bulletin Bb-188.

Dehumidifier
Lectrodryer systems, employing activated alumina for drying air and gases by absorption, are described in an attractively illustrated booklet by the Pittsburgh Lectrodryer Corp., Pittsburgh. Bulletin Bb-187.

Heroult Furnace
Revised and expanded to include modern major innovations in the construction and operation of the Heroult electric furnace, a new edition of the American Bridge Co.'s Heroult Electric Furnace Bulletin is now ready for distribution. Bulletin Bb-124.

Duronze
An 80-page technical handbook covering the physical properties and applications of four high strength silicon bronzes pioneered by Bridgeport and sold under the trade name "Duronze alloys" has been released by the Bridgeport Brass Co. Bulletin Bb-163.

Carbonate Remover
A material for use in removal of carbonate from plating solutions is described in a new Electroplating Service Bulletin issued by Grasselli Chemicals Department of E. I. du Pont de Nemours & Co. Bulletin Bb-95.

Seamless Tubes
Just prepared by the Timken Steel and Tube Division of the Timken Roller Bearing Co. is a "Guide for Users of High Temperature Steels," which presents technical data relating to the various properties of Timken seamless tubes. Bulletin Bb-71.

Cleaning Processes
An attractive 12-page booklet entitled "Scientific Metal Cleaning" has been published by Detroit Rex Products Co. It describes in detail the applications and advantages of Detrex degreasing with Perm-A-Clor or Triad Safety Solvents and the applications of Triad Alkali Cleaning Compounds and Strippers. Bulletin Oy-111.

Pipe and Tubes
Handbook and price list containing practical and technical information on Misco "Centricast" pipe and tubing (stainless, corrosion and heat resisting) is available from Michigan Steel Casting Co. Bulletin Bb-84.

Heat Treating
A folder by Industrial Heating Equipment Co. explains and illustrates diagrammatically a continuous type heat treating furnace in which temperatures can be held to within extremely close limits, and in which the product is always uniformly heated. Bulletin Ga-168.

New Enduro Book
The fruit of a tremendous amount of research on the part of Republic Steel Corp.'s metallurgists is contained in a handsome booklet giving general applications and extensive tabular matter on physical and chemical properties of 13 types of Enduro stainless steels. Bulletin Ny-8.

Chromel
A new catalog has been issued by Hoskins Mfg. Co. covering Hoskins electric furnaces and Chromel elements, which provide uniform heat and automatic temperature control with excellent production and quality of work. Bulletin Ia-24.

Abrasive Cleaning
Comprehensive information on airless abrasive metal cleaning is contained in a new book on the "Wheelabrator" Tum-Blast, a patented mechanical device made by the American Foundry Equipment Co. Bulletin Fa-112.

Rotoblast
A new blast cleaning machine eliminates the need for compressed air as the abrasive driving agent. Pangborn Corporation tells how a rapidly spinning wheel propels the abrasive by controlled centrifugal force. Bulletin Ox-68.

Heat Treat Chart
Heat treaters everywhere should find a heat treating wall chart complete with S.A.E. specifications a very valuable addition to their shops. Published by Chicago Flexible Shaft Co., manufacturers of Stewart industrial furnaces. Bulletin Ka-49.

Salt Bath Furnace
The revolutionary advance in electric furnace design incorporated in the Ajax-Hultgren electric salt bath furnace is described and illustrated in a bulletin by Ajax Electric Co. Bulletin Bb-43.

Certified Steels
Ryerson certified steels are the result of many years spent developing new specifications, new methods of control and complete readjustment of stocks. An interesting book by Joseph T. Ryerson & Son, Inc., tells the complete story. Bulletin Ab-106.

Ni-Cr Castings
Compositions, properties, and uses of the high nickel-chromium castings made by The Electro Alloys Co. for heat, corrosion and abrasion resistance are concisely stated in a handy illustrated booklet. Bulletin Fx-32.

Carbottom Furnaces
Operating data, illustrations, interesting text, are featured in the folder by Surface Combustion Corp. on carbottom furnaces for general heat treating purposes. Bulletin Bb-51.

Laboratory Service
A new edition of "The Metal Analyst" tells about an organization established by Adolph I. Buehler specializing in the installation of metallurgical laboratories. The complete line of laboratory equipment marketed by Buehler is also catalogued. Bulletin Dy-135.

Park-Kase
A leaflet by Park Chemical Co. contains complete information concerning a new liquid carburizer of rapid and uniform penetration. Unique features and advantages of the bath are backed up with technical data. Bulletin Na-141.

Oil at Its Best
A booklet of generally useful information to metal working concerns using soluble cutting oil is offered by D. A. Stuart Oil Co., Ltd. The data should be of value in increasing soluble oil efficiency and consequent plant economy. Bulletin Na-118.

Stiffness Testers
The stiffness test is especially valuable on materials in the form of thin sheet, strip, rod, and wire which are difficult to test by the usual tension, hardness and ductility methods. A new line of stiffness testers is described by Tinius Olsen Testing Machine Co. along with complete instructions for making test. Bulletin La-147.

Scleroscopes
Shore Instrument & Mfg. Co. describes its Model D standard recording scleroscope in a recent bulletin which explains the theory and practice of hardness testing with this machine. Bulletin S-33.

Newer Tool Steels
Vulcan Crucible Steel Co. has a complete and attractive catalog listing their full line of tool steels including many special types to meet the modern trends in industry. Bulletin Jy-127.

Ingot Production
"The Ingot Phase of Steel Production" is the title of a book defining the principles of quality ingot production followed by many well-known steel manufacturers. Gathmann Engineering Co. Bulletin Ka-13.

Pictorial Story
A pictorial and descriptive story of the manufacture of steel products by The Youngstown Sheet and Tube Co. is in reality a textbook of basic steel information contained in a 115-page, leather-covered, pocket size ring binder. Bulletin La-93.

Stainless Data Book
All users of stainless and heat resisting alloys should find invaluable the information contained in a booklet published by Maurath, Inc., giving complete analyses of the alloys produced by the different manufacturers, along with the proper electrodes for welding each of them. Bulletin Jy-125.

Murex Electrodes
Featured in a pocket-size pamphlet which describes the entire Murex line of some 20 types of welding rods are two new electrodes for manual arc welding. Metal & Thermit Corp. Bulletin Bb-64.

Mo-W High Speed
J. V. Emmons, metallurgist for Cleveland Twist Drill Co. and largely responsible for the development of the molybdenum-tungsten high speed steels known as Mo-Max, has prepared a general description of these new steels. Bulletin Ka-103.

Meehanite
A compact but complete specification chart gives the recommended grades of Meehanite metal for various service requirements. Complete physical properties and applications are included. Bulletin Da-165.

Electric Salt Baths
Literature is available from Bellis Heat Treating Co. describing electrically heated bath furnaces which are economical to operate and have a wide range of applications in hardening, annealing and heat treatment of high speed steel, stainless steel, nickel, aluminum, copper and bronze, etc. Bulletin Ny-48.

Electronic Control
Exactly how the electronic principle is used to insure exact automatic control of furnace temperature is told and full data given on the "Alnor" pyrometer controller made by Illinois Testing Laboratories, Inc. Bulletin La-180.

The Review
7016 Euclid Ave., Cleveland

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The Junior Members' Own Page

The Story of Steel ~ *From Soaking Pit to Rail Mill*

"I'm afraid I'll have to confess, Al, it's a mystery to me how they ever make rails out of these big chunks of steel you call ingots."

"Well, here we are at the rail mill, Bob, so you can see for yourself. But first of all the ingots have to be sent to the soaking pit."

"Whatever is a soaking pit?"

"You see, when the ingots are removed from the molds, they are still red hot but not uniformly so. They're not hot enough to roll satisfactorily either, and the outside is considerably colder than the center of the ingot."

"Are these some coming in now? Gee, they're hot enough to be a regular bright cherry red."

"Those are just on their way to the soaking pit. Do you see these big overhead cranes? One of these will move to a position where those big tongs you see will grip the ingot and move it from the ingot buggy and place it in one of the soaking pits."

"What happens to it in the soaking pit?"

"Soaking pits are really furnaces heated by gas. The ingot is thoroughly and uniformly heated until its temperature is the same on the outside as in the center."

"How hot are they then?"

"They're about 2350° F.—just hot enough to be soft but not molten."

"How long does it take to heat them in the soaking pit?"

"About three or four hours. Then they are taken out, one at a time, and brought down below us, still in an upright position on a transfer car, to the point where the ingot starts in the mill. The operator of the car dumps it by turning it down on its side, and now it's all ready for its trip through the mill."

"Why do they call it a rolling mill, Al?"

"Did you ever watch your mother roll out dough for pies with a rolling pin? Well, it's the same idea except that the steel passes between two rolls like the rolls of a clothes wringer."

"Why don't they call it a wringing mill then?"

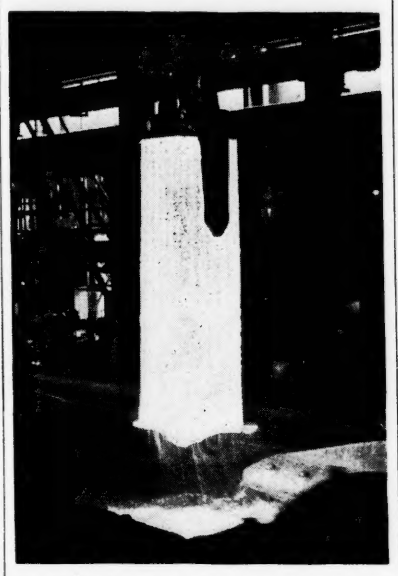
"Listen, dope, because it happens to act more like rolling dough. The steel passes through a series of rolls spaced at intervals, each set of rolls lengthening the ingot out and reducing its cross-section until it finally gets to be the desired shape just like dough is rolled to the desired shape by the rolling pin."

"Okay, Al, you win."

"Here we are now at the end of the rail mill where the ingot starts through. Before it gets to be a rail it will have passed 18 times through successive stands of rolls."

"But these first rolls don't look as though they would shape it into anything like the form of a rail."

"They don't, Bob. It's only after nine or ten passes that it starts to go



Ingot of Steel Being Lifted From Soaking Pits, After It Has Been Heated to the Proper Temperature for Rolling Into Rails. Photos Courtesy Carnegie-Illinois Steel Corp., Gary Works

through rolls that are modified in contour so as to form the shape of the rail."

"Now if the ingot keeps getting narrower all the time, it must be getting a lot longer too, isn't it?"

"Oh, yes, it's only 7½ ft. long when it starts and nearly 240 ft. long after the last pass."

"Wow! That must be a pretty long rail."

"They cut that up into six full-length rails 39 ft. long each."

"Wait a minute, Al, 240 divided by six is more than 39."

"Granted, smart guy, but stop and think a minute. The rails are sawed apart when they are hot—about 1850° F. They are 39 ft. 8 in. long then but only 39 ft. when they cool to room temperature."

"Why, I never thought steel would shrink that much when it cooled, Al."

"It does though. Another interesting thing about the cooling is that from the finishing temperature of about 1850° F., the steel contracts steadily until it reaches about 1350°. The metallurgist calls this the critical temperature, and at that point it expands instead of shrinking. Then as it cools below this temperature, it continues to contract again."

"And I suppose you know just why it acts that way and all. But what on earth are we coming to? Is it the Fourth of July?"

"No, just sawing the rail to the 39-ft. lengths, Bob. Quite a sight, isn't it?"

"And how! Those saws don't waste any time going through that hot steel, do they, Al?"

"No, it only takes 7/10 of a second to saw through a rail. The peripheral speed of the hot saws is three miles per minute. Cutting steel at 1850° F. at that speed gives some real pyrotechnics."

"Well, Al, all I can say is that I'll never look at a rail or any other pieces of steel again without thinking of all the spectacular things that happened to it from the time it was nothing but a heap of iron ore!"

The End

Sawing the Red Hot Rail — A Mechanical Pyrotechnic Display

Metals Are Joiners

By William J. Schwarz

(Winner of Second Prize in Contest Announced in December Issue)

METALS, like men, do not care to live alone. Just as men desire to live in groups such as families, villages, cities, etc., so metals like to "join up" with other elements. The more corrosive (as they may be called) metals are the least discriminating in their choice of associations. Some choose their associates from the air, some from the water, and others from the ground.

An extreme example of the great desire of a metal to join with other elements is the action of pure sodium metal in water. The violent union of the sodium with water completely consumes the metal. While this peculiar phenomenon may be given some term other than corrosion, still it shows how much metals do not like to remain aloof from other elements.

This explains, too, why the metal sodium is never found in its free state, and for very similar reasons other metals, especially our old friend iron, are found in ores united to other elements, particularly oxygen; hence the fact that iron ores are generally the oxides of iron. During the smelting processes, the iron is "divorced" from the oxygen and the other minerals in the ore.

But for some reason, old man iron will not stay alone for very long. After his smelting-divorce episode, he heads straight from Reno to Gretna Green to get hitched up to some more elements.

Certain conditions play the part of Cupid and aid this "marriage" or corrosion process. Water is the outstanding matrimonial bureau, for several reasons. One explanation of the fact that water induces corrosion, is the fact that it contains various dissolved gases, liquids, or even solids which the metals are prone to join.

Then, too, water is the great carrier of electricity, and it thus "keeps the spark of love still burning," that is, the love of metals to unite with other elements. This water forms the solution for a kind of electric battery. In the liquid of this battery will be found, among other things, oxygen's little brother, hydrogen.

Hydrogen is regarded by some men as the tricky "match-maker" which plays all sorts of pranks on metals. When it is around, it just tantalizes brother oxygen and other relatives, until sooner or later some metal gets "hooked" and becomes united to the family. In most cases, oxygen is the bridegroom. Thus corrosion results.

There are, however, some metals which are rather more aloof than others. These are the so-called "noble" metals, outstanding among which are gold and platinum. These metals are not very quick to join up with the various elements in air and water, but they can be made to join with other elements only under very special circumstances; a sort of "shot-gun marriage" you might call it.

Nevertheless, due to the fact that these metals are very reluctant about choosing a permanent mate, they are dubbed "non-corrosive."

Mehl Honored By Penn State

Chapter Holds Dinner for Priestley Lecturer

The Penn State Chapter held an informal dinner on March 22 at the Nittany Lion Inn in State College in honor of Dr. Robert F. Mehl, 1938 Priestley lecturer.

This dinner was in special recognition of the fact that for the fourth year of the 12 in which the Priestley lectures have been given at Pennsylvania State College, the series has been again devoted to the applications of physical chemistry to metallurgy. Previous lecturers in this field have been Dr. Samuel L. Hoyt in 1928, Dr. Eric R. Jette in 1933, and Dr. Mathew A. Hunter in 1935.

The Priestley lectures—a series of five on the application of physical chemistry to other related fields of science—were inaugurated in 1926 by members of the faculty of the Department of Chemistry as a memorial to the discoverer of oxygen.

Dr. Mehl's lectures on "Reactions in Solid Alloys" dealt with the subject under the following five headings:

Mar. 21—Reaction in the Solid State
Mar. 22—Diffusion in Solid Metals
Mar. 23—Precipitation from Solid Solution
Mar. 24—Eutectoid Decompositions
Mar. 25—Formation of Surface Reaction Layers

Opportunities Revealed In Field of Cast Iron

By Max Bolotsky

Missouri School of Mines Group—Opportunities in the field of cast iron metallurgy were revealed to the group and guests on Feb. 4 by Carl H. Morken, director of sales engineering, Carondelet Foundry Co., St. Louis.

Speaking on the "Influence of the Elements Entering Into Cast Iron," Mr. Morken disclosed the vast and still undeveloped field that has been opened by the introduction of alloying elements into cast iron.

The speaker dwelt especially on graphitization, its effects, causes, and control, and illustrated with a series of slides the enhanced physical properties that result from the proper addition of such metals as nickel, chromium, molybdenum, and titanium to regulate the graphite content of the iron.

Design Fundamentals Applied to Various Classes of Cast Iron

Two Speakers at Joint Meeting With Foundrymen

By C. W. Horack

Golden Gate Chapter's January meeting was held jointly with the Northern California Chapter of the American Foundrymen's Association. Harold T. Avery, chief engineer of the Marchant Calculating Machine Co., and Ivan L. Johnson of the A. F. A. presided.

The first speaker was Wm. W. Kerlin, metallurgist for the Meehanite Corp. He started his discussion on "Design of Castings," by outlining certain fundamentals of design as they might be applied to the various classes of cast iron.

The effect of mass influence on the strength of iron is of utmost importance in the application of strength data to casting section. The higher tensile irons are less influenced by the slow cooling of a heavy-walled casting, and, therefore, specifying higher tensile materials is often more effective in increasing the total strength of a casting than merely increasing the section of a lower tensile material.

The fact that many of the higher tensile irons, say about 50,000 psi., have a definite value of *E* under the proportional elastic limit, permits their use in heavy-walled valves and cylinders. This is because most heavy-walled vessels fail by strain rather than excessive stress.

The talk was closed by a discussion of the use of fillets, ribs, placement of bosses and design of internal cores. Proper cooperation between the designer, pattern shop, foundry and rate fixing department was emphasized.

Mr. Johnson introduced the second speaker, Capt. E. D. Almy, U.S.N. Engineering Officer, Battle Force. Captain Almy discussed some of the casting problems encountered in naval construction. He explained how casting design has been greatly improved through systematic research.

Inventor of Hazelett Process Is Speaker

(Continued from page 1)

idly (about ½ sec. maximum in contact with the roll), yet the pressure close to the freezing point causes segregation in alloys. To date no cure has been found for this when the metal is cast and rolled in the same mill.

The problem of oxidation is of great importance with some metals. It can be eliminated to a certain extent by the method of casting, but to produce an oxide-free metal, the casting must be done under a protective atmosphere.

As would be expected, the low melting point metals and alloys have given the least trouble in fabrication. For example, thin storage battery plates of antimony lead were the subject of Mr. Hazelett's first experiments. The most modern machine for this purpose supplies the sheet directly to a stamping machine where the plates are stamped out and the scrap is carried by gravity immediately into the furnace where it is remelted.

Aluminum was one of the most difficult to process, because of the ease of oxidation and adherence to the rolls.

Stainless steel, Monel metal, nickel, zinc, copper, and brass are among the metals that have been successfully cast by this process; however, the finish, particularly on alloys, is somewhat inferior to that demanded for certain applications.

An experimental plant for carrying out this work on steel and other high melting point metals has been built during the past year. This contains a 36-in. casting mill for steel, constructed according to the latest casting process, which produces a cast strip of metal in which no appreciable segregation occurs. The strip, while still hot, is carried directly to a standard rolling stand to give it the necessary work.

A lively discussion was held under the technical chairmanship of E. M. Wise, assistant manager of the International Nickel Research Laboratory.

just off the press

METALLOGRAPHIC TECHNIQUE FOR STEEL

BY J. R. VILELLA

Research Laboratory
U. S. Steel Corporation
Kearny, New Jersey

EVER since Mr. Vilella presented his three lectures on Metallographic Technique at the Atlantic City Metal Congress we have been besieged with requests for this material in book form.

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CHAPTER CALENDAR

APRIL

Chapter	Date	Place	Speaker	Subject
Baltimore	Apr. 4	Engineers Club		Tool Steels
Boston	Apr. 1	Chamber of Commerce		Sustaining Members Night
Buffalo	Apr. 15		G. B. Waterhouse	Joint Meeting With Ontario
Calumet	Apr. 12	Woodmar Country Club, Hammond, Ind.	H. F. Moore	Physical Testing of Metals
Canton-Mass	Apr. 15	Hotel Onesto	Quinn Tamm	Operations of Federal Bureau of Investigation
Chicago	Apr. 14	Medinah Club	G. C. Riegel	Inspection of Steel and Cast Iron
Cincinnati	Apr. 14	Alms Hotel	H. W. McQuaid	The Latest in Gas Carburizing
Cleveland	Apr. 4	Cleveland Club	S. L. Hoyt	Metallurgical Laboratory Practices
Dayton	Apr. 13	Engineers Club	R. G. Guthrie	Carburizing
Dayton	Apr. 27			Corrosion (Tri-Chapter Meeting)
Detroit	Apr. 11		C. H. Herty, Jr.	Progress in Steel Making
Hartford	Apr. 12	Hartford Electric Light Co. Auditorium	W. A. Wesley	Plating and Corrosion Resisting Coatings
Indianapolis	Apr. 18	Washington Hotel	A. E. Krogh	Control of Furnace Atmospheres
Lehigh Valley	Apr. 22			
Los Angeles	Apr. 14	Southern Calif. Edison Co. Auditorium	Alex L. Robb	Materials Used in Diesel Engines
Mahoning Valley	Apr. 11	Tod Hotel	Jerome Strauss	Vanadium as an Alloying Element
Milwaukee	Apr. 19	Milwaukee Athletic Club	V. O. Homerberg	Nitriding
Montreal	Apr. 4			Manufacture and Uses of Steel Strip
New Haven	Apr. 21	Seven Gables Inn, Milford, Conn.	J. A. Durr	Malleable Iron
New Jersey	Apr. 11	Essex House, Newark	H. W. Gillett	Furnace Atmosphere Control
New York	Apr. 11	Building Trades Employers Association Club Rooms	I. I. Sikorsky	Aircraft of the Near Future
North West	Apr. 12	Minnesota Union, University of Minnesota	W. E. Benninghoff	Differential Hardening by Induction
Notre Dame	Apr. 13	Engineering Auditorium, University of Notre Dame	K. R. Van Horn	Industrial Applications of X-Rays
Ontario	Apr. 8	Hamilton, Ont.	A. A. Bates	
Ontario	Apr. 22	Buffalo	G. B. Waterhouse	Joint Meeting with Buffalo
Oregon	Apr. 7	Lloyd's Club House	W. P. Woodside	History of Alloy Steels
Oregon	Apr. 29	Lloyd's Club House	V. W. Whitmer	Stainless Steels
Peoria	Apr. 11	Pere Marquette Hotel	G. B. Waterhouse	
Philadelphia	Apr. 29	Engineers Club	K. R. Van Horn	Recent Advances in Non-Ferrous Alloys
Pittsburgh	Apr. 14	Roosevelt Hotel	W. H. Swanger	Significant Failures of Metals in Service
Rhode Island	Apr. 6	Engineering Society Bldg.	A. J. Snyder	Cutting Tools
Rochester	Apr. 11	University of Rochester	J. P. Gill	Tool Steels
Rockford	Apr.	Elks Club	G. B. Waterhouse	
Saginaw Valley	Apr. 19	Durant Hotel, Flint, Mich.	D. L. Gibb	Plastics
Schenectady	Apr. 19	Rensselaer Polytechnic Institute, Troy, N. Y.	A. W. F. Green	
Southern Tier	Apr. 28	Cornell University, Ithaca, N. Y.	John Johnston	Progress in Study of Steel (Tri-Chapter Meeting)
Springfield	Apr.		S. Horn	Temperature Control Instruments
Syracuse	Apr. 12	Ithaca, N. Y.		Joint Meeting with Southern Tier
Texas	Apr.		C. F. Lewis	Physical Testing
Tri-City	Apr. 12	Rock Island Arsenal	G. B. Waterhouse	National Officers Night
Washington	Apr. 11	Garden House, Dodge Hotel	S. M. Weckstein	Roller Bearings
Worcester	Apr. 7	Sanford Riley Hall, Worcester Polytechnic Institute	H. H. Harris	Heat Resisting Alloys
York	Apr. 20	Harrisburg, Pa.	T. Holland Nelson	

MAY

Baltimore	May 2	Engineers Club	Louis Moses	Flow of Steel in Rolling
Boston	May 6	Massachusetts Institute of Technology	R. F. Harrington	Recent Progress in Cast Iron
Boston	May 20	Massachusetts Institute of Technology		New England Regional Meeting
Calumet	May 10	Woodmar Country Club, Hammond, Ind.	H. W. Graham	Steel Making Processes and Metallurgical Requirements
Chicago	May 12	Medinah Club	Norman B. Stotz	High Speed Steel
Cincinnati	May 12	Alms Hotel		Carborundum Co. film
Cleveland	May 2	Cleveland Club	F. M. Becket	Stainless Steel
Columbus	May 21	The Trees		Election and Picnic
Dayton	May 11	Engineers Club		Panel Discussion
Detroit	May 9	Hotel Fort Shelby	J. R. Townsend H. M. Webber	Special Purpose Metals Electric Furnace Brazing
Hartford	May 10	Bristol Brass Corp.	J. L. Christie	Common Wrought Brasses
Indianapolis	May 16	Washington Hotel		Round Table Discussion
Los Angeles	May 12	Southern Calif. Edison Co.		Materials Used in Aviation
Mahoning Valley	May 9	Tod Hotel, Youngstown		Inaugural Meeting
Milwaukee	May 19	Milwaukee Athletic Club	J. H. Mathews	Criminology
Montreal	May 2	Windsor Hotel	G. B. Waterhouse	
New Haven	May 12	Strathcona Hall, Yale University	G. B. Waterhouse	Steel Making
New Jersey	May 9	Essex House, Newark	G. B. Hogaboom	Metal Coatings
New York	May 9		N. L. Deuble	Metallurgical Inspection
North West	May 10			Annual Meeting
Notre Dame	May 11	Engineering Auditorium, University of Notre Dame	V. N. Krivobok	Corrosion Resisting Alloys
Ontario	May 6	Toronto	E. C. Bain	Basis of Steel Hardenability
Oregon	May 6			Annual Meeting
Penn State	May 20 and 21	State College, Pa.		Third Biennial Pennsylvania Inter-Chapter Meeting
Pittsburgh	May 12	Roosevelt Hotel	John Chipman	Segregation in Rimming Steel Ingots
Rochester	May 9	University of Rochester		
Saginaw Valley	May 10	Bancroft Hotel, Saginaw, Mich.	Carl F. Joseph	Malleable Iron
Schenectady	May 24	Wolferts Roost Country Club, Albany		Annual Meeting
Southern Tier	May 16	Elmira, N. Y.	F. E. Tuttle	High Speed Photography
Syracuse	May 10			Annual Banquet
Texas	May 5			Annual Meeting
Tri-City	May 10	Rock Island Arsenal	Roy Allen	Trouble Shooting on Steel Problems
Washington	May 9	Dodge Hotel	G. B. Waterhouse	National Officers Night
Worcester	May 5	Sanford Riley Hall, Worcester Polytechnic Institute		Symposium on Quenching